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CASE REPORT

Popliteal Artery Entrapment Syndrome (PAES)—a Missed Diagnosis

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Abstract
Popliteal artery entrapment syndrome (PAES), a rare vascular developmental anomaly, occurs due to abnormal relationship between popliteal artery and the myofascial structures in the popliteal fossa. It is classically found in young, athletic, and non-smoking male. Patient may be asymptomatic or may present with claudication or rest pain. The signs and symptoms are related to either stenosis, occlusion, aneurysmal dilatation of popliteal artery or due to distal embolization. PAES is classified into six types (type I–VI) depending on relationship between popliteal artery and medial head of gastrocnemius around popliteal fossa. Diagnosis remains challenging as symptoms mimic other vascular conditions like peripheral arterial occlusive disease (PAOD), thromboangiitis obliterans (TAO), adventitial cystic disease (ACD), fibro-muscular dysplasia (FMD), small- and medium-vessel vasculitis etc. CT angiogram and MRI are the investigations of choice and surgery is considered as the mainstay of treatment. Surgery is highly rewarding and recurrence is very rare. We hereby report a case of PAES, which was mis-diagnosed and mis-treated as early onset peripheral vascular disease over a period of three years. PAES with popliteal artery occlusion was suspected clinically, confirmed on imaging and treated successfully by popliteal artery (P1-P3) reverse saphenous vein graft (RSVG) with favorable outcome.

Keywords Popliteal artery entrapment syndrome (PAES) · Popliteal artery thrombosis · Reverse saphenous vein graft (RSVG) · Claudication

Introduction

Popliteal artery entrapment syndrome (PAES) is a rare vascular condition, seen in only 3.5% of cases at post-mortem [1]. It is a developmental anomaly which occurs due to abnormal relationship between popliteal artery and the myofascial structures in the popliteal fossa [2]. Patients with PAES have varied presentation; they may be asymptomatic, may have features of arterial insufficiency, and may present as popliteal artery aneurysm with or without features of distal embolization [3]. Diagnosis of PAES always remains challenging due to its atypical presentation. We hereby report a case of PAES, which was initially mis-diagnosed as a peripheral vascular disease for almost a period of three years, until patient was reported and diagnosed at our center.

Case Report

A 28-year-old gentleman, chronic smoker, reported to a peripheral surgical center with complaints of progressive claudication right leg of one month duration. Pain used to start in calf muscles after walking 100 m and used to subside completely after taking rest. Patient was initially diagnosed and treated as a case of early onset peripheral vascular disease. He was advised smoking cessation and started on antiplatelet, statin, and phosphor-di-esterase-3 inhibitor. Despite on medication, patient noticed decrease in painful-walking distance (PFWD) to 40–50 m over next two years. In view of persistent and worsening symptoms, patient reported to the intervention radiologist; an arterial color Doppler was carried out, which revealed significant

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stenosis of right popliteal artery, for which he underwent popliteal artery angioplasty. Patient symptoms did not improve with angioplasty and condition further worsened over next one year hence, reported to vascular center for the first time with complaints of disabling claudication right leg (PFWD of 20–25 m) which was hampering his day-to-day activities. On examination, popliteal and distal pulses were absent in right leg, whereas left leg pulses were normal. Ankle Brachial Index (ABI) of the right and left limbs was 0.54 and 0.98 respectively. CT angiogram of lower limbs revealed complete occlusion of right popliteal artery (P2 segment) and existence of an accessory muscle sling, arising from medial head of gastrocnemius, causing external compression over the popliteal artery (Fig. 1). MRI of the right lower limb further confirmed type-III PAES with popliteal artery occlusion (Fig. 2). In view of occluded popliteal artery with external compression by the muscle sling, a surgical bypass was considered. P1 to P3 segment popliteal artery bypass was done by medial approach using reverse saphenous vein graft (RSVG) harvested from the ipsilateral thigh (Fig. 3). In post-operative period, patient was kept on injectable anti-coagulation (Inj Lower Molecular Weight Heparin 1 mg/kg body weight, subcutaneous, twice a day), broad spectrum antibiotics, analgesics, and supportive care. Ambulation started after 24 h, thigh and leg drains were removed on 3rd and 4th day respectively, and patient was discharged on 10th post-operative day on oral anticoagulation with palpable distal pulses and patent GSV graft on Doppler ultrasound. Patient was continued on low dose oral anticoagulation

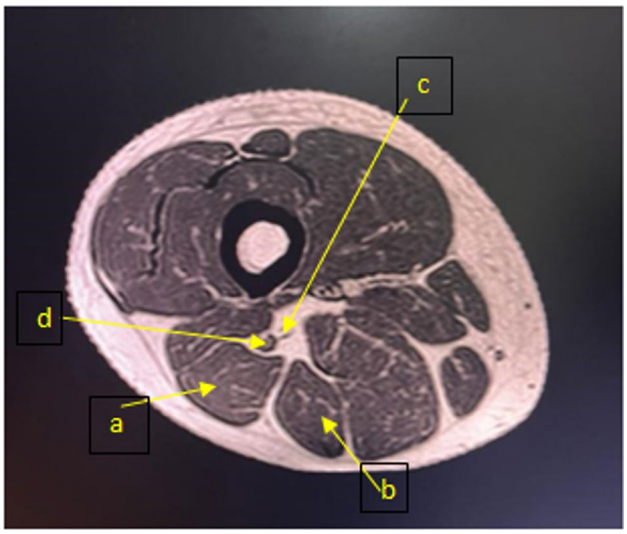

Fig. 2 MRI right leg – coronal view. **a** Medial head of gastrocnemius; **b** Lateral head of gastrocnemius; **c** Fascial sling arising from medial head; **d** Occluded popliteal artery

(Apixaban 2.5 mg twice a day) and single antiplatelet drug for six months which were discontinued thereafter. Post surgery, patient had significant improvement in his symptoms. At present, after one year of surgery, he can walk up to 5–6 km and climb stairs without pain, he has palpable distal pulses (DPA/PTA) and has an Ankle Brachial Index (ABI) of 0.94 in operated limb (equal to contralateral normal limb). Follow-up CT angiography shows a patent vein graft (Fig. 4).

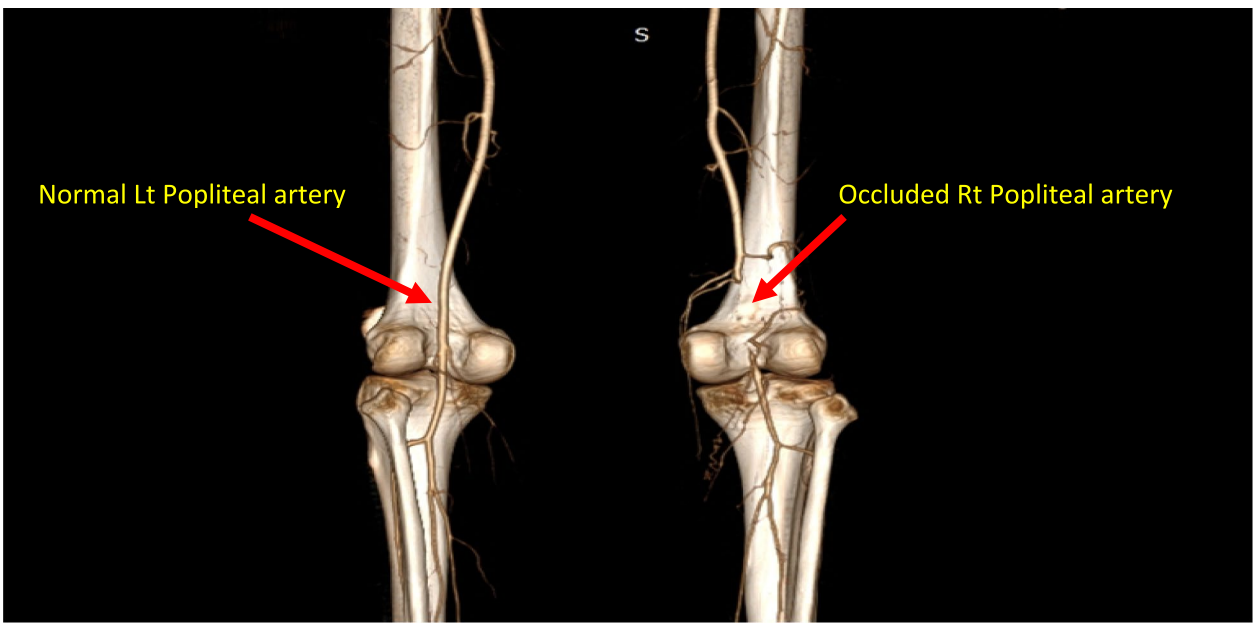

Fig. 1 Pre-op CT angio bilateral lower limbs (reconstructed posterior view) shows occluded right popliteal artery (P2 segment) and patent left popliteal artery

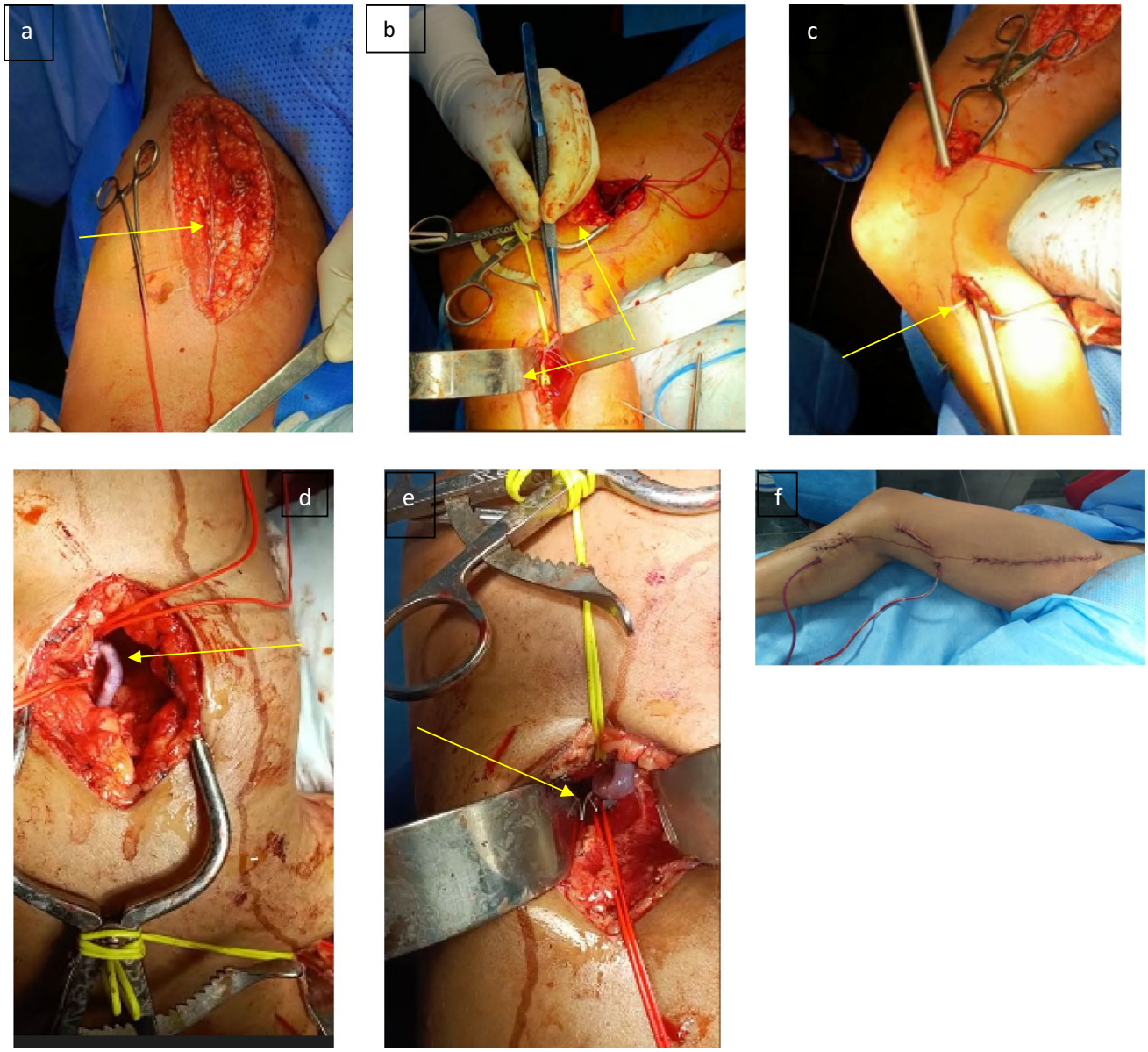

Fig. 3 **a** GSV harvested from ipsilateral thigh; **b** Proximal (P1) and distal (P3) popliteal artery exposure; **c** Tunneller in subfacial plain for transferring vein graft from supra-genicular (P1) inflow segment to infra-genicular (P3) outflow segment; **d** Proximal anastomosis between popliteal artery (P1 segment and proximal end of reverse saphenous vein graft; **e** Distal anastomosis between distal end of reverse saphenous vein graft and popliteal artery (P3 segment); **f** Wound closure thigh (vein harvest site], supra-genicular, and infra-genicular for vascular reconstruction with closed drainage tubes in situ

Discussion

Popliteal artery entrapment syndrome (PAES) occurs due to abnormal relationships between myofascial structures and the corresponding popliteal artery in popliteal fossa and is classified into six types (Table 1). In our case, it was type III, in which a sling of fibrotic band, which was arising from medial head of gastrocnemius, was compressing on the right popliteal artery. The compression on popliteal artery results in various limb symptoms, (Table 2). Patient in reported case had class 3 symptoms, as his claudication distance was less than 100 m. PAES is most commonly seen in young and active males [1] and the most common symptom includes pain in the calf following exercise which gets relieved after taking rest [2]. Clinically, there can be absent or reduced popliteal and distal leg pulses, especially while performing a forced dorsi-flexion of foot. Our patient had absent popliteal and distal pulses, due to complete occlusion of popliteal artery. In PAES, Doppler ultrasound (DUS) can help in visualizing hemodynamic changes occurring due to external

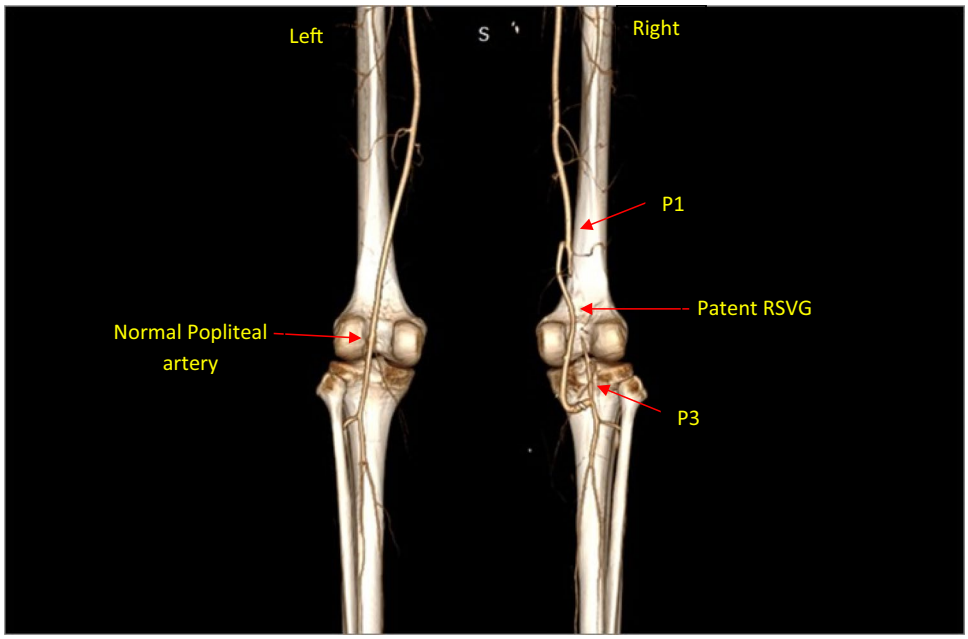

Fig. 4 Post-operative CT angio (bilateral lower limbs): Patent reverse saphenous vein graft (RSVG) between P1 and P3 popliteal segment on the right side

Table 1 Heidelberg Classification of PAES

Type	Description
I	Popliteal artery is displaced medially and beneath the gastrocnemius (or its tendon). The gastrocnemius's medial head remains normal. This occurs as the popliteal artery completes development before the migration of the medial head of the gastrocnemius
II	Medial head of gastrocnemius arises from an abnormal attachment on the lateral aspect of the medial femoral condyle/intercondylar area, resulting in compression on popliteal artery
III	Gastrocnemius muscle has a fibrous band or additional tendon which inserts laterally resulting in external compression on popliteal artery
IV	It is due to the persistence of the axial artery as the mature distal popliteal artery
V	Popliteal artery and popliteal vein both are compressed
VI	Normal artery and myofascial development but arterial compression is due to hypertrophy of popliteus or gastrocnemius muscle

Table 2 Classification of PAES based on severity of symptoms

Class	Description
0	Asymptomatic
1	Pain, paresthesia or cold feet after physical activities
2	Claudication (after > 100 m)
3	Claudication (< 100 m)
4	Rest pain
5	Tissue loss (ulcer/necrosis)

compression especially with dynamic ankle maneuvers [4]. Magnetic resonance imaging (MRI) has stood the test of time and is proven to be the investigation of choice to evaluate the anatomy of the popliteal fossa and understanding the relationship between the popliteal artery and its surrounding structures [5]. CT angiography or conventional angiography can detect compression/occlusion/ aneurysm. In our case, CT angiography revealed popliteal artery occlusion with external compression, which got further confirmed by MRI. Angioplasty or endovascular treatment remains ineffective in PAES, as it does not correct external compression, and hence surgery is considered as treatment of choice [6]. If the disease is diagnosed early with patent popliteal artery, a simple open surgical exploration with fasciotomy, myotomy, or fibrous band excision and release of external arterial compression is sufficient. If the patient has intimal injury with stenosis of popliteal artery, thrombo-endarterectomy with a venous patch repair remains a viable therapeutic option [2], but, if the patient has complete occlusion of popliteal artery, exclusion of occluded segment by using vein bypass is essential. In the reported case, we bypassed the occluded popliteal segment, using reverse saphenous vein graft. The outcome is good after surgical treatment, as we saw in our case. If it remains undiagnosed or mis-diagnosed, it always remains a threat to the limb.

Conclusion

Popliteal artery entrapment syndrome is a rare vascular condition. Its diagnosis is difficult due to varied presentation and overlapping symptoms with other common vascular conditions. It requires a high index of suspicion for the diagnosis and warrants an early treatment to prevent limb complications. In the reported case, patient was initially mis-diagnosed as early onset peripheral arterial occlusive disease, and was in-appropriately treated with angioplasty without identifying and relieving external compression to the artery. After patient reported to our center, PAES was suspected clinically, confirmed on imaging and was successfully treated with surgical bypass resulting in favorable outcome.

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Declarations

Ethical Approval Ethical approval for conducting the study and publication of the case report had been taken from institutional ethical committee. Written and fully informed consent had been taken from the patient for publication of this case report and accompanying images.

Conflict of Interest The authors declare no competing interests.

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